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(54) High-voltage transformer.

(57) The transformer comprises a primary winding (5) and a secondary winding (7), the latter being composed of several sections (9, 10, 11) coaxially aligned at spaced locations and interconnected through rectifyer means (13, 14). The sections of the secondary winding comprise respective coils composed of a laminar conductor (15) wound on an insulating film (16) to form identical numbers of windings. Each winding of each coil (9, 10, 11) is aligned with the corresponding winding of the other series-connected coils. The transformer is of very simple construction and does not require to be tuned.

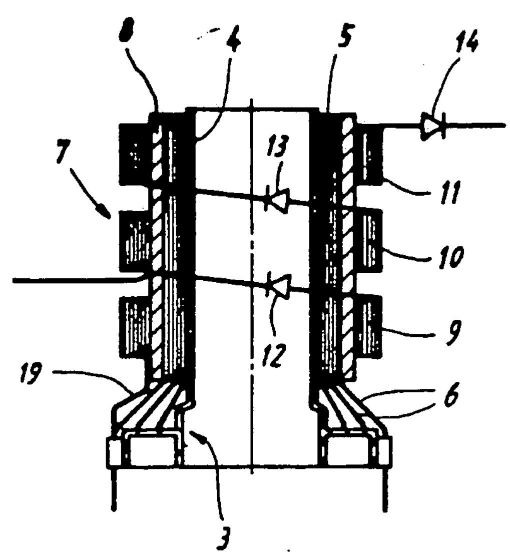

Fig. 1

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High-Voltage Transformer

The present invention relates to an electric high-voltage transformer to be employed for example for the power supply to a cinescope or the like.

The power supply of a television cinescope usually amploys a high-voltage transformer of the so-called "Fly-Back Transformer" (FBT) type.

As generally known, an FBT transformer comprises at least a primary winding and a secondary winding made of insulated copper wire. In particular, the secondary winding comprises a plurality of winding sections interconnected through rectfyer means so as to form a voltage multiplyer making use also of the parasite capacities between the respective sections. From a structural point of view, the sections of the secondary winding are formed by a single winding operation to be coaxially disposed side by side along a common core.

As also known, the secondary winding comprises a very great number (several thousands) of windings, and the current flowing therethrough is rather weak (on the order of 1 mA), so that it is preferable to employ a particularly thin copper wire in order to limit the overall dimensions of the transformer.

The copper wire forming the secondary winding normally has a diameter of about 40 μm and is therefore rather fragile, so that the winding operation has to be done very cautiously. In addition, the small diameter of the copper wire renders an accurate positioning of the individual windings of the secondary practically impossible, so that the distribution of the parasite capacities between the individual windings of the various sections becomes disadvantageously irregular.

As further known, the efficient coupling between the transformer and an associated cinescope requires the impedance of the secondary winding to be minimized. In an FBT trans-former this is accomplished by tuning the transformer to a harmonic (normaly the ninth harmonic) of the deflection frequency of the cinescope, which may for instance be 15.625 Hz.

In practice the tuning of the transformer is carried out by varying the reciprocal coupling between the primary and secondary windings, for example by varying the number and the axial positions of the individual windings of the secondary winding. For the reasons set forth above, this operation is obviously indesirably difficult and laborious. It is also to be noted that the tuning of the transformer is influenced by the impedance of the yoke of the cinescope, so that the tuning has to be changed whenever there is a variation of the characteristics of the associated cinescope.

For minimizing these inconveniences it is frequently preferred to replace the FBT transformer by a transformer of the so-called "Diode Split Transformer" (DST) type.

A DST transformer is described for example in GB Patent 1,090,995, and comprises a primary winding normally made of an aluminum sheet carried on an insulating strip, and a secondary winding comprising a plurality of sections made of insulated copper wire. The sections of the secondary winding are concentrically disposed one within the other and Wound on respective cylindrical cores, the end portion of one section being connected to the start portion of the next section through a rectifyer. As a result, the difference of potential between successive individual windings is substantially constant, so that the parasite capacity distributed between all windings of a section of the secondary winding and the adjacent winding of the next section is likewise uniform. This transformer does thus not require any particular tuning for coupling it to a cinescope.

On the other hand, however, even in a DST transformer the copper wire of the secondary winding is particularly thin for reason of dimensions, as a result of which the winding operation is rather delicate, and the positioning of the individual windings is relatively imprecise with regard to their concentricity with respect to the axis of the core. In addition, the assembly of the DST transformer is rendered rather complicated and expensive by the necessity of forming each section of the secondary winding in a separate step before mounting the sections concentrically with one another.

An object of the present invention is the provision of a high-voltage transformer combining the advantages of the conventional prior art solutions while minimizing their disadvantages.

More particularly, an object of the present invention is the provision of a high-voltage transformer capable of being manufactured in a simple and precise manner while presenting a particularly low impedance value.

A further object of the invention is to provide a high-voltage transformer of the type defined above, which presents particularly compact dimensions.

These objects are attained by a high-voltage transformer comprising at least a primary winding and a secondary winding having several sections, the sections of the secondary winding being disposed about a substantially cylindrical support in coaxial spaced alignment with one another, and connected in series through rectifyer means. According to the invention, the transformer is primarily characterized in that the sections of the secondary winding comprise respective coils composed of at least one laminar conductor wound onto said

support over an insulating film. The windings of each coil are aligned with corresponding windings of the other series-connected coils.

The laminar conductor preferably comprises the metal layer on a metallized insulating film, this metal layer having a resistance value of no more than 0.52Ω□.

The characteristics and advantages of the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings wherein:

fig. 1 shows a diagrammatical sectional view of a transformer according to an embodiment of the invention, and,

fig. 2 shows an enlarged perspective view of a component for making the transformer of fig. 1.

The high-voltage transformer according to the invention is designed to operate at relatively high frequencies, for example at least 15.625 Hz, and adapted to be used in the power supply of a consumer, for instance a cinescope.

With reference to fig. 1, the transformer essentially comprises an insulating support frame 3 having a substantially cylindrical portion 4 acting as the winding core of at least one primary winding 5 having terminals 6.

Primary winding 5 is preferably formed by winding a metal strip, for instance aluminum, about core 4 onto an insulating film; this manufacturing technique is per se known and described for instance in EU-A-0,126,365, which relates to a SMT transformer, i.e. a transformer which finds its application in a field completely different from that of the transformer according to the invention, in which there are specific functional problems to be solved as will be described.

Primary winding 5 is magnetically coupled to a secondary winding generally indicated at 7 and disposed about a substantially cylindrical insulating support 8 surrounding primary winding 5.

Secondary winding 7 is composed of a plurality of winding sections coaxially disposed at spaced locations. Fig. 1 shows three such sections indicated at 9, 10 and 11.

One terminal of section 9 is connected to a ground terminal 19, while its opposite terminal is connected to the adjacent terminal of section 10 through a rectifyer 12 or the like.

The other terminal of section 10 is again connected to the adjacent terminal of section 11 through a rectifyer 13. The opposite terminal of section 11 is adapted to be connected to a cinescope (not shown) through a further rectifyer 14.

The sections 9, 10 and 11 of the secondary winding are thus interconnected in series through respective rectifyers 12 and 13 in a per se known manner, to thereby form a voltage multiplyer by making use of the parasite capacities (not shown) forming between individual windings of the respective winding sections 9, 10 and 11 during operation at high frequencies.

With reference also to fig. 2, according to one aspect of the invention each section 9, 10, 11 of secondary winding 7 is formed as a separate coil made by winding at least one laminar conductor 15 overlying at least one insulating film 16 about support 8, film 16 being a plastic material or paper.

As in the case of primary winding 5, laminar conductor 15 may be an aluminum strip of a width smaller than that of insulating film 16, so that the latter projects at opposite sides to thereby ensure proper electric insulation of the individual windings of the coil.

In particular, coil sections 9, 10 and 11 preferably have the same number (several hundreds) of windings, and all windings of all sections are rpeferably coaxially aligned with one another. Each winding of each coil is thus aligned with the corresponding winding having the same circumferential dimension of the other series-connected coils.

As will be evident to those skilled in the art, the parasite capacities formed in operation between the windings of coil 9 and the corresponding windings of coil 10, and between the latter and the corresponding windings of coil 11, will then practically be of the same magnitude.

Without any necessity of tuning the transformer, there is thus obtained a secondary winding 7 having a constant capacity distribution and thus a low impedance value.

It is also evident that secondary winding 7 can be advantageously and readily formed by contemporaneously winding coils 9, 10 and 11 in a single winding operation. Although the overall dimensions of the transformer remain substantially unchanged, it is to be noted that this winding operation offers no critical problems thanks to the mechanical strength of conductor 15 and insulating film 16 as compared to conventional solutions employing a thin wire as a conductor.

According to another aspect of the invention, the overall dimensions of the transformer can be noticeably reduced when conductor 15 is integrally formed with insulating film 16 in the form of a metallized film. This runs of course contrary to a technical prejudice, in that the aluminum layer of conventional metallized films is extremely thin, having a maximum thickness of about 0.1 μm, and therefore presents an excessively high resistance, at least 10Ω□, for use in a transformer.

In contrast thereto, according to the present invention the metal layer 15 of the metallized film employed for making secondary winding 7 is of a thickness selected to result in a particularly low resistance of no more than 0.5Ω□.

In the preferred case, in which the metal layer

is made of aluminum, this requirement is met when metal layer 15 has a thickness of at least 0.1 µm; this value lies preferably between 0.1 and 2 µm, the overall thickness of the metallized film being about 3 to 10 µm.

In a per se known manner, the electric connections of the coils 9, 10 and 11 are established during the winding operation by the insertion of metal strips 17 in contact with metal layer 15. Suitable terminals 18 may then be secured to metal strips 17 as by soldering.

From the above description it is evident that the highvoltage transformer according to the invention is of particularly compact dimensions, in addition to the advantages already explained. This results from the employ of a conductor 15 and insulating film 16 of a particularly small thickness, and irrespective thereof, of optimum mechanical strength, as already explained.

In addition it is to be noted that the metal layer 15 having a resistance of no more that 0.51Ω□ is not self-regenerating (contrary to what happens for example in many electric capacitors), so that a locakized short-circuit possibly occurring between windings adjacent metal strips 17 will not cause to an undesirable electric insulation.

The described transformer may of course undergo various modifications within the scope of the invention.

It is thus possible to vary the electric connections and thhe number of coils 9, 10, 11, or the laminar conductor 15 may be of another material, for instance copper.

Furthermore primary winding 5 of the transformer may also be made in the conventional manner with the conductor in the form of a wire, or the coils 9, 10 and 11 may be made of respective laminar conductors of different width.

Claims

1. A high-voltage transformer comprising at least a primary winding and a secondary winding composed of several sections, said sections of said secondary winding being disposed about a substantially cylindrical support at coaxially spaced locations and interconnected in series through rectifyer means, characterized in that said sections of said secondary winding (7) comprise respective coils (9, 10, 11) formed of at least one laminar conductor (15) wound about said support (8) on an insulating film (16), the windings of each coil being aligned with corresponding windings of the other series-connected coils.

2. A transformer according to claim 1, characterized in that all of said coils (9, 10, 11) have the same number of windings.

3. A high-voltage transformer according to claim 1, characterized in that said laminar conductor (15) comprises the metal layer of a metallized insulating film.

4. A high-voltage transformer according to claim 3, characterized in that said metal layer (15) has a resistance of no more than 0.5Ω□.

5. A high-voltage transformer according to claim 3, characterized in that said metal layer (15) is of aluminum and has a thickness of between 0.1 and 2 µm.

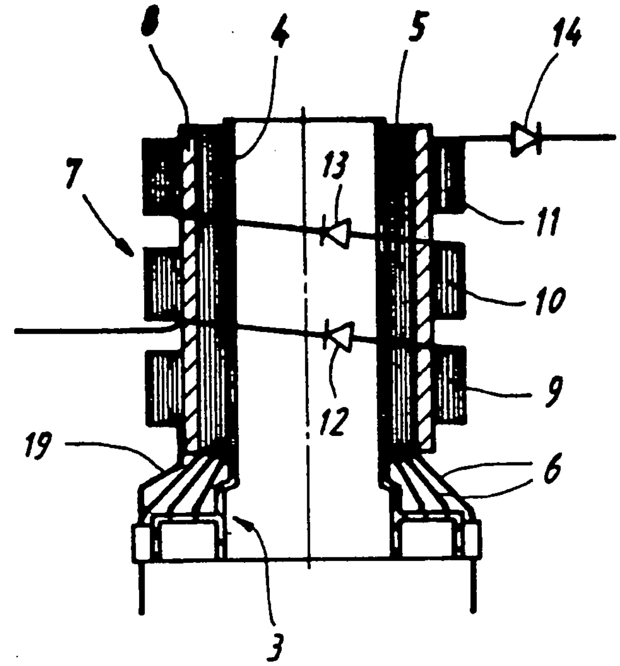

Fig. 1

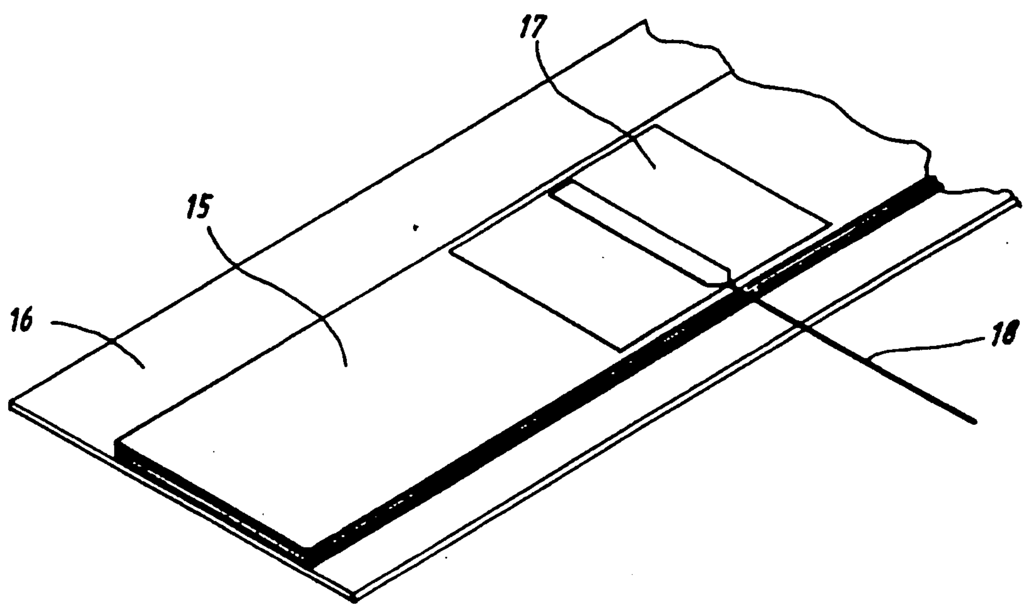

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 10 5566

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	EP-A-0 047 497 (BLACK) * Page 3, line 15 - page 4, line 12; figures 1,2 * ---	1-3	H 01 F 19/00 H 01 F 27/28
X	DE-A-2 930 008 (PETRICK) * Page 5, lines 17-28; page 6, line 21 - page 7, line 21; figures 3-7 * -----	1-3,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 01 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12-07-1988	BIJN E.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document